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14. ABSTRACT The aim of this grant was to support a summer training program for undergraduate students interested in biomedical research, especially cancer-related research. The students selected for the program participated in cancer-related basic research for a 10-week summer period in the Department of Molecular Medicine, University of Texas Health Science Center at San Antonio. Each student was assigned a faculty mentor and placed in a laboratory, depending on their expressed interests. Each student participated in actual research in the mentor's laboratory during the summer, and attended weekly seminars to learn about topics relevant to breast cancer research. At the end of the summer, each student made a formal presentation to the entire department about their summer research project. The aim of the proposal was to expose talented young scientists to biomedical research, with the hope of attracting some of them to pursue biomedical research careers. Over the last four summers, this grant has supported 27 participating students. 66% of the participants were female, and 30% were from underrepresented minority populations. The program has been of great benefit to all involved.					
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Table of Contents

	<u>Page</u>
Introduction.....	4
Body.....	4
Key Research Accomplishments.....	5
Reportable Outcomes.....	7
Conclusion.....	8
References.....	8
Appendices.....	8

INTRODUCTION

This undergraduate summer training award was designed to fund fellowships to support talented undergraduate students to perform cancer-related research during 10-week summer periods each year. The purpose of this undergraduate training program was to expose talented young students to cancer-related research in the context of a real research laboratory. Each selected student was assigned a faculty mentor, and they participated in a research project in the mentor's laboratory. Students also attended weekly undergraduate-level seminars to learn about topics relevant to breast cancer research, and they each gave a formal presentation on the work they performed at the end of the fellowship period. The hope was that this program will attract talented young people to train as scientists and pursue cancer research as a career. In the past four years of the program, this grant has supported 27 different undergraduate students for summer research. At least 5 of these 27 students has entered (or will enter in fall 2007) a Ph.D. program to pursue a research career after completing the summer fellowship program.

BODY

Since 2003, this grant has supported 27 different undergraduate students in a summer research program in the Department of Molecular Medicine / Institute of Biotechnology at the University of Texas Health Science Center at San Antonio. The program is a 10-week internship program, in which the students are assigned to a participating faculty mentor. Each student spends the summer in the mentor's laboratory, performing research as a full-time job. Since the students are assigned to different laboratories, each student works on a different research project. The students also attend Friday lunchtime cancer research seminars geared specifically to an undergraduate audience. At the end of the summer, students present their summer work in a formal presentation to the entire department.

The applicant pool has grown each year, suggesting an increased awareness of our program. For the 2003 program, we received 31 applications. In the last year supported by this grant (2006), we received 120 applications. For this year's program, we received 185 applications, from schools in 29 different states. The largest number of applicants (generally 40-50%) attend public and private Texas universities. The large increase in applications each year has allowed us to be somewhat more selective in choosing student participants. The student applicant quality is excellent. The overall average GPA for student participants in the DOD-supported program (2003-2006) was 3.62. Since the pool of applicants is so high, we have been able to select out those applicants who we feel have a genuine interest in cancer research. Since our aim was mainly to reach students who are US citizens, most (25 of 27) of the participants funded by this proposal were US citizens. The other two were international students from Mexico and Bulgaria studying at US universities and planning to attend graduate school in the US.

As shown in Table 1 below, the 27 student participants have come from 22 different US colleges and universities. 18 (67%) attended 13 different Texas schools, including both public (UT-Austin, UT-Pan American, UT-El Paso, UT-Dallas and UT-San Antonio) and private (St. Mary's University, Rice University, Abilene Christian

University, Texas Lutheran University, St. Edward's University, Baylor University, Trinity University and Austin College) universities. 9 participating students (33%) came from public or private universities in 8 different states (Hawaii, Nebraska, Colorado, New York, Wisconsin, Pennsylvania, Louisiana and North Carolina). Of the 27 students who participated in the DOD-funded program from 2003-2006, 18 (67%) were female and 9 (33%) were male. 8 students (30%) identified themselves as being members of minority groups that are underrepresented in the sciences (mainly Hispanic).

Table 1. Student Participants and their characteristics.

NAME	SCHOOL (State)	GENDER	MINORITY	MENTOR	YEAR
Broderick, Rose	St. Mary's Univ (TX)	F	Yes	P.R. Yew	2003
Fajardo, Charlene	Chaminade Univ (HI)	F	Yes	T. Boyer	2003
Kepler, Kristen	Univ. Nebraska (NE)	F	No	E.P. Hasty	2003
Wickley, Aaron	BYU-Hawaii (HI)	M	Yes	H. Rao	2003
Wilson, Brian	UT-Austin (TX)	M	No	A. Tomkinson	2003
Yanez, Maria	UT-Pan Am (TX)	F	Yes	S.E. Lee	2003
Baran, Sean	Univ. Colorado (CO)	M	No	P.R. Yew	2004
Gordon, Claire	Rice Univ. (TX)	F	No	T. Boyer	2004
Gray, Nathan	Abilene Christian U. (TX)	M	No	S.E. Lee	2004
Kim, Pamela	Vassar College (NY)	F	No	M. Gaczynska	2004
Martinez, Sonia	Texas Lutheran U (TX)	F	Yes	B. Chatterjee	2004
Swearingen, Alan	St. Edward's U (TX)	M	Yes	E.P. Hasty	2004
West, Christopher	St. Mary's Univ (TX)	M	No	B. Chatterjee	2004
Breen, Rebecca	Baylor Univ. (TX)	F	No	B. Chatterjee	2005
Eckblad, Jackie	Univ. Wisconsin (WI)	F	NO	P.R. Yew	2005
Endel, Lydia	St. Mary's Univ (TX)	F	No	Y. Suh	2005
Garcia, Claudia	UT-El Paso (TX)	F	Yes	M. Gaczynska	2005
Helmke, Kara	UT-Austin (TX)	F	No	S.E. Lee	2005
Highland, Heather	Trinity Univ. (TX)	F	No	H. Rao	2005
West, Christopher	St. Mary's Univ (TX)	M	No	B. Chatterjee	2005
Wollish, Amy	Bucknell Univ. (PA)	F	No	T. Boyer	2005
Angelova, Maggie	Louisiana State U (LA)	F	No	B. Chatterjee	2006
Davis, Laura	UT-Dallas (TX)	F	No	H. Rao	2006
Davis, Natasha	UT-San Antonio (TX)	F	No	P.R. Yew	2006
Fried, Justin	Davidson College (NC)	M	No	M. Gaczynska	2006
McDonald, Sam	Austin College (TX)	M	No	S.E. Lee	2006
Moshfeghian, Audrey	UT-San Antonio (TX)	F	Yes	Y. Suh	2006

KEY RESEARCH ACCOMPLISHMENTS

Since this is a training grant, we do not have many research accomplishments to report. However, one of our student trainees has published a paper resulting from the work that was done in her summer internship. Ms. Laura Davis is a student at the University of Texas, Dallas. She performed research in Dr. Hai Rao's laboratory during the summer of 2006. She worked on two different projects related to regulated protein degradation. One involved looking at the effects of mutations on the substrate specificity of the 26S proteasome, and the other involved analyzing degradation of human prion

protein by the yeast proteasome. Some of the work that she did was published in a paper entitled “Proteasome Inhibition in Wild-Type Yeast *Saccharomyces cerevesiae* Cells”, in the journal BioTechniques (Liu, C., Apodaca, J., **Davis, L.E.** and Rao, H., volume 42#2, February 2007). Another student trainee from summer 2006, Audrey Moshfeghian, presented the work that she performed in the laboratory of Dr. Yousin Suh at a national meeting, the Annual Biomedical Research Conference for Minority Students (ABRCMS) in Anaheim, California, in November 2006. Audrey received a monetary award for her presentation, on the subject of genetic determinants of disease in bone.

During the period of the grant funded by the DOD, we have advertised our program in a number of ways, received and evaluated student applications, provided summer research opportunities to undergraduate students, organized and participated in educational weekly summer seminars to expose students to breast cancer-related research, and organized formal student presentations at the end of the summer fellowship period. During the period of this DOD training award, the fellowship program has been quite successful. For the summers of 2003, 2004, 2005 and 2006, we supported 27 undergraduate student participants using these funds, with the addition of a small amount of departmental funds. Two of our past students (Christopher West, summer 2004 & 2005 and Lydia Endel, summer 2005) enrolled in our Molecular Medicine Ph.D. program in order to pursue cancer-related research careers. Another student participating in our weekly student seminars via another undergraduate summer program at the UTHSCSA also joined our Ph.D. program. Of the six students participating in the program for summer 2006, 3 will begin graduate school in the fall of 2007 to pursue Ph.D. degrees in the biomedical sciences. Audrey Moshfeghian will attend Johns Hopkins University to pursue her degree in Human Genetics, and Natasha Davis will attend the University of Texas, Austin. Finally, Maggie Angelova will enter our Molecular Medicine Ph.D. program. The number of applicants to this summer internship program has increased dramatically during the course of this training program. For the summer of 2003, we received 31 applications, while we received 120 applications for the summer of 2006. Part of the increase may be due to our increased efforts at publicizing the program by contacting and/or visiting Texas schools and by providing information on our departmental website. On the other hand, there appears to be a very large demand for internship programs in the biomedical sciences among a large number of serious students interested in careers in science and medicine. We believe that we fill a very important need to allow students interested in science to experience “real” research as opposed to the laboratory coursework that they get at school. This allows them to determine whether they have the interest and aptitude to pursue research as a career, and we hope to interest more of these young scientists in cancer-related research.

Table 2. Listing of all personnel receiving pay from the research effort (alphabetical), their role in the research effort and time of participation.

Angelova, Magdalena	Student participant	Summer 2006
Baran, Sean	Student participant	Summer 2004
Breen, Rebecca	Student participant	Summer 2005
Broderick, Rose	Student participant	Summer 2003
Christy, Barbara	Principal Investigator	2003-2006
Davis, Laura	Student participant	Summer 2006
Davis, Natasha	Student participant	Summer 2006
Eckblad, Jackie	Student participant	Summer 2005
Endel, Lydia	Student participant	Summer 2005
Fajardo, Charlene	Student participant	Summer 2003
Fried, Justin	Student participant	Summer 2006
Garcia, Claudia	Student participant	Summer 2005
Gordon, Claire	Student participant	Summer 2004
Gray, Nathan	Student participant	Summer 2004
Helmke, Kara	Student participant	Summer 2005
Highland, Heather	Student participant	Summer 2005
Kepler, Kristen	Student participant	Summer 2003
Kim, Pamela	Student participant	Summer 2004
Martinez, Sonia	Student participant	Summer 2004
McDonald, Samuel	Student participant	Summer 2006
Moshfeghian, Audrey	Student participant	Summer 2006
Swearingen, Alan	Student participant	Summer 2004
West, Christopher	Student participant	Summers 2004,2005
Wickley, Aaron	Student participant	Summer 2003
Wilson, Brian	Student participant	Summer 2003
Wollish, Amy	Student participant	Summer 2005
Yanez, Maria	Student participant	Summer 2003

REPORTABLE OUTCOMES

One publication resulted from the summer student research supported by this training grant. Laura Davis, a student at the University of Texas, Dallas, was an author on a publication from Dr. Hai Rao's laboratory resulting from the work that she performed last summer (Liu, C., Apodaca, J., Davis, L.E. and Rao, H. Proteasome inhibition in wild-type yeast *Saccharomyces cerevisiae* cells. *BioTechniques*, 42: 158-162, 2007). Another student from the summer of 2006, Audrey Moshfeghian, won a cash award at a national meeting for her presentation of the work performed in the laboratory of Dr. Yousin Suh last summer. A third student, Natasha Davis, continued the work she began in Dr. Renee Yew's laboratory over the course of the school year as her Senior Thesis project for the Honors College at the University of Texas, San Antonio. Finally, the Principal Investigator presented a poster and abstract describing the training program at the Era of Hope Meeting, Department of Defense Breast Cancer Research Program, in

Philadelphia, PA, June 2005. The title of the poster/abstract was “Summer Undergraduate Fellowships in Breast Cancer-Related Research in San Antonio”. In addition to these outcomes, at least 5 student participants decided to enter graduate school and pursue careers in biomedical research.

CONCLUSION

In conclusion, this DOD undergraduate training grant has supported 27 undergraduate students from US colleges and universities to perform summer research in breast cancer-related research in the Department of Molecular Medicine, University of Texas Health Science Center at San Antonio. The students participated for a 10-week summer period during the summers of 2003, 2004, 2005 and 2006. During this period, 9 different faculty members acted as mentors for these 27 students. In addition to performing research in the laboratories, the students attended weekly lunchtime undergraduate-level lectures in cancer-related research topics. At the end of the summer, the students presented their work in a formal seminar presentation to the whole department and invited guests. The participating students, faculty mentors and the Department of Molecular Medicine are all enthusiastic about the program and have judged it a success.

REFERENCES

Not applicable to this training grant.

APPENDICES

No appendices.

SUPPORTING DATA

No supporting data.